ELSEVIER
Available online at www.sciencedirect.com
ScienceDirect
Procedia Economics and Finance 6 (2013) 353 – 363
Procedia
Economics and Finance
www.elsevier.com/locate/procedia

International Economic Conference of Sibiu 2013 Post Crisis Economy: Challenges and Opportunities, IECS 2013

Carbon Footprint Analysis: Towards a Projects Evaluation Model for Promoting Sustainable Development

Andreea Lorena Radu[a], Marian Albert Scrieciu[a], Dimitriu Maria Caracota[a*]

[a]*Faculty of Management, The Bucharest University of Economic Studies, Bucharest, Romania*

Abstract

Climate change and global warming are internationally recognized as current issues, driving negative effects on humanity, and being mainly caused by GHG emissions generated both from industrial activities, and from other anthropogenic activities. Restoring the ecological balance requires urgent action to reduce GHG emissions. In this respect, the European Union has set the target to reduce the GHG emissions by 20% until 2020, compared to 1990 level. This paper presents a methodology to develop a model for carbon footprint calculation, for assessing and reducing GHG emissions generated by European funds financed projects.

Selection and peer-review under responsibility of Faculty of Economic Sciences, Lucian Blaga University of Sibiu.

Keywords: carbon footprint; sustainable development; European funds; protected area; GHG.

1. Introduction

Environmental protection has now become a major concern, especially following the significant negative consequences involved by the economic development promoted since the industrial revolution. People become

* Corresponding author.
E-mail address: andreea.radu@man.ase.ro

Selection and peer-review under responsibility of Faculty of Economic Sciences, Lucian Blaga University of Sibiu.
doi:10.1016/S2212-5671(13)00149-4

progressively aware of their activities implications on the environment, and are increasingly interested in reducing and correcting the adverse effects.

A growing number of studies, research and collected data, reveal the existence of a direct relationship between climate change and carbon dioxide emissions (CO2) (IEA, 2012). According to the Fourth Assessment Report prepared by Intergovernmental Panel on Climate Change (IPCC), activities of all nations generate increasingly more GHG emissions, having significant negative impacts on climate change due to alterations taking place in the compositional level of the atmosphere, and also on rising the average global temperature since the mid of the 20th Century (IPCC, 2007).

The main elements that generate large amounts of carbon dioxide are fossil fuels (especially oil and coal), through burning them for obtaining energy. Of all the greenhouse gases, CO2 has the largest share. Thus, emissions of other greenhouse gases (CH4, N2O, HFC, PFC, SF6) are converted in units of CO2 equivalent (CO2e), using the warming potential related to each gas.

Among the adverse effects of GHG emissions we can mention: global warming, decreasing water availability for humanity, pollution of air, water and soil, melting ice caps and increasing oceans level, degradation of the ozone layer, extreme weather events, changes of the seasons, reducing biodiversity, desertification.

The PWC Report (2012) "Low Carbon Economy Index" concludes that a 5.1% annual rate is required for decrease of GHG emissions by 2050, in order to achieve our target of planetary warming with maximum 2oC. In 2011, this rate was 0.7%, while the average starting from 2000 is 0.8%. The reduction target was not reached during the last period, on the one hand because of the increasing emissions in emerging countries and, on the other hand, due to insufficient involvement of other countries in objectives achieving, materialized in uncertain policies on national and international level, reduced efforts for low emissions technologies and even a decline in renewable energy field. In the relationship between economic growth and evolution of generated emissions, the latter has an asymmetrical trajectory, increasing with a higher rate than the economic growth, but more slowly decreasing compared with the economic decrease.

Currently, there are two methods to combat the effects of GHG emissions:

- Reducing the level of emissions;
- Flexible trading mechanisms in the carbon certificates market: acquiring the rights to emit GHGs by owning a carbon certificate/license.

Within the Kyoto Conference in 1997, the treaty to reduce the GHG emissions was established and for stabilizing the gases concentration in the atmosphere. A total of 192 countries have signed the agreement to reduce emissions by 2012, with an average of 5% compared to the 1990 level. If a country does not fulfill its reduction target, surpassing the assumed rate, it is forced to buy allowances from countries that have not consumed theirs. Thus, the mandatory market for carbon certificates was created.

The first cause concerned in generating GHG emissions is the energy industry. Burning fossil fuels to obtain energy generates most GHG emissions, so that enterprises in this area „must proactively develop technologies and processes to reduce emissions and play an active role in shaping the carbon trading mechanism to be used". Some experts believe that the market for trading carbon emissions can be a beneficial demarche both for companies and also for the planet – in the long term, because it involves an efficient and rapid method for emissions reduction in the energy industry. (Deloitte, 2010)

Aichele and Felbermayr (2011) argue that the Kyoto Protocol has been ineffective or possibly even environmental harmful, due to the emergence of carbon leakage, through increasing of the emissions generated by imports and carbon emissions reallocation.

In parallel with the mandatory market for carbon certificates, the voluntary market for carbon certificates is operating, giving the owner of one certificate the right to offset one tonne of CO2e emission, based on the fact that the certificate was issued after a project for reducing emissions with one tonne in atmosphere. Voluntary market has the advantage that supports financially the research-development- innovation projects, in the field of carbon emissions, having concrete results for new and sustainable technologies (renewable energy).

The emissions reduction can be achieved using technology and materials that generate fewer gases, but also through compensating the generated emission, by creating absorption capacity for carbon emissions. By photosynthesis process, trees convert carbon dioxide into oxygen and other organic compounds necessary for life. Thus, afforestation can reduced the effects involved by GHG emissions.

Another cause that contributes to the greenhouse effect is soil pollution, in particular through massive deforestation (Munteanu et al., 2011, pp 12, 18-19). The measures implemented by Romania to reduce GHG emissions include Joint Implementation (JI) projects, in collaboration with other states, to achieve the technology transfer for GHG decreasing and for energy efficiency, improvement of environmental quality and biodiversity conservation. JI projects consist in: construction of Combined Heat and Power – CHP units; use of the low-carbon fuels in industrial equipment and energy production; promoting non-conventional energy; methane recovery from urban landfill; reducing greenhouse emissions in the sector of agriculture, energy and transport; activities for afforestation and/or reforestation of degraded land. (ANPM, 2011, pp 39-40).

In this sector, an important role is held by protected areas both to maintain biodiversity, geodiversity, conservation of the ecosystem with complex features, and to increase the sequestration capacity of GHG on national level. Maintaining biodiversity through the protected areas is necessary, not only for sustaining life in the present,but also for future generations because it maintains the regional and global ecological balance, guaranteeing regeneration of biological resources and maintaining environmental quality (air, water, soil) that are necessary for the society.

Sustainable development is an objective of the European Union, declared and assumed in the last development strategy: Europe 2020. In 2008, the European Parliament made a commitment to reduce GHG emissions by 20% until 2020, compared to the value from 1990. Consistent with this objective, each member state has undertaken its own GHG reduction targets. Thus, Romania has assumed a 20% reduction in GHG emissions by 2020. Our country is currently ending its first programming period 2007-2013, when European funds have been accessed for strategic investments both for human development and technological capital, and for natural capital, considering the principles of sustainable development.

Given the assumed target of reducing GHG emissions, we believe that in the next programming period 2014-2020 it is necessary a greater involvement at all levels to achieve the goals. In this respect, we consider useful to integrate a model in the Guides for Applicants of the european funds, initial having low complexity, to calculate the carbon footprint of emissions generated from the proposed project. In this paper we present the methodology to develop such a model, which should be national available for any potential grant applicant, and will create both a comparability system of projects in terms of emissions (in order to select the most competitive) and a monitoring system for reduced emissions, so that each project financed by EU funds will contribute to the national objective of reducing GHG emissions.

2. Carbon footprint and measuring methodologies

The "carbon footprint" term was developed in the 90's, deriving from the concept of "ecological footprint" (Ercin and Hoekstra, 2012), but addressing the measurement of the climate change impacts. The concept began to be publicized independently, since 2005 and refers to the impact of human activities on the environment and especially on the climatic conditions, in terms of greenhouse gases emissions (or briefly called " carbon emissions"). According to Wiedmann and Minx (2008), the carbon footprint is "the total amount of greenhouse gas emissions (GHG) caused by an organization, event or product".

Carbon footprint calculation serves as an assessment tool in terms of GHG emissions and then, it serves to manage and reduce these emissions. After calculating the carbon footprint, its detailing helps to identify weaknesses - areas of high emissions that can be eliminated or improved. Thus, carbon footprint is an indicator of sustainable development.

Internationally, numerous methodologies and models for calculating carbon footprint were developed, both on individual level or a product / service, organization / institution level but also for communities, nations and even at global level. Thus, we distinguish several studies and reports on the carbon footprint, developed by various international institutions and organizations, both private (especially NGOs) as well as public, but the literature does not fully cover the topic: there are gaps both concerning its definition and its application in practice. Due to the multitude of models and calculation methodologies, there is no uniform or universally accepted method for calculating the carbon footprint. However, more and more companies, especially multinationals ones, are willing to make an effort to calculate the carbon footprint and to disseminate the results. In some cases, it can be observed a greater intention and a concrete mobilization on the individual and organizational level than on governmental level.

In this case, the organizational benefits refer both to corporate social responsibility, and to marketing activities through gaining a competitive advantage on the sustainable development promoter image and protector of the environment.

Certain international standards provide guidance on the methodology for calculating carbon emissions, depending on the studied aspect (product/organization/project/community). ISO 14064 Standard consists of 3 series for GHG inventories, quantifying and reducing the GHG emissions for the major projects, and for their validation and verification; ISO 14040 and 14044 Standards refer to the life cycle analysis of products and services and their impact on the environment; ISO 14067 Standard (in development) will be dedicated to measuring the carbon footprint of the product during its life cycle (Bratu, 2010). PAS 2050 methodology, developed in 2008, is addressed to industrial organizations that aim to calculating the carbon footprint of products. Developed based on previous standards, it offers some technical specifications for calculation (Lundie et al, 2009).

IPCC methodology is the most formalized reference, globally accepted for quantifying GHG emitted by system. The IPCC Guide is used for the elaboration of GHG inventories on national level. The IPCC database, including emission factors for all activity sectors, is best used on national level, but also in the individual/organizational models, including those using LCA method (Lundie et al, 2009).

Emission factors are values for correlating the amount of pollutants emitted into the atmosphere and the associated activity to generate that type of pollutant. Emission factors are calculated as average values in the long term, by interpreting technical informations, documents of emission testing, emission continuous monitoring systems. Globally, there are available several databases for emission factors, among which the IPCC (Melanta, 2010). GHG Protocol developed by the World Resources Institute and World Business Council for Sustainable Development is the most used standard for organizations and businesses, considering all three emission levels possible to be generated (Wiedmann and Barett, 2010).

According to Nielsen et al. (2009), the existing methodologies are still in development, and even if some of them emphasize the importance of the carbon footprint calculation, taking into account all the necessary details, none of them provides sufficient computing breakdowns. For current methodologies do not yet meet all the completeness requirements, carbon emissions sector has not reached maturity for mandatory implementation of these methodologies. In case of products methodologies, none of these has been sufficiently tested to determine its global applicability (Ernst&Young, 2010).

Wiedmann and Minx (2007) describe two methods to calculate the carbon footprint using LCA: process analysis (PA) and Environmental Input-Output Analysis (EIO). The process analysis is a bottom-up approach to analyze a product from creation to the end of its life, taking into account direct and some secondary emissions, but having the disadvantage of double counting. EIO involves a top-down approach and is applied on sectoral level, expanding boundaries and eliminating the problem of double counting. The authors recommend the application of a hybrid model, combining advantages of the two methods: using EIO as primary method, and locally applying the PA.

The analyzed emissions within such a model are divided into three levels, depending on the control power of the organization/community on their sources:

- scope 1: direct emissions, for activities directly controlled by the organization/ community;
- scope 2: indirect emissions, derived from the use of electricity, heat and cooling;
- scope 3: other indirect emissions, from downstream and upstream (along the supply and retail chain).

Matthews et al. (2008) concluded that the first 2 emission levels cover only part of the total footprint of a company, especially for the supply chain. Using the EIO-LCA model and detailing each upstream purchased product / service, involve significant emissions that should be taken into account. On the other hand, in case of complex products, a number of stakeholders can assume responsibility in the supply chain (raw material manufacturer, producer of adjuvant materials or other elements incorporated into the product), and so the problem of double counting appears. To solve this problem, Lenzen introduced the concept of "shared responsibility" between supply chain members, but having serious difficulties in implementation (Matthews et al., 2008).

Among the limits assigned to the carbon footprint we mention ignoring potentially toxic aspects in communicating a product's environmental impact. But the most important disadvantage is the lack of harmonization for calculation methodologies on international level: there are competitive standards and even contradictory on some points, due to lack of coordination for standardization. The multitude of existing methodologies and calculation models lead to confusion on choosing the best alternative to be applied. Also, working with approximate values can distort the result of the calculation, especially in areas where there is a lack of information on the process production and estimated values are used instead. The aspect of double counting is significantly when carbon footprints is calculated on national or global level.

Even if it presents numerous disadvantages, the carbon footprint industry is previewed to be intensively developed in the coming years, offering impressive opportunities for companies. Reducing carbon emissions will generate both cost reduction, and differentiation for products and brands, resulting competitiveness growth of the companies to reduce carbon footprint (Suryata, 2010).

3. Carbon footprint of investment projects financed by international institutions

In this section, we intend to describe several methodologies for developing carbon footprint analysis for investment projects. Given the analysed subject, we considered appropriate to study certain methodologies implemented by other institutions that finance investment projects. Thus, we analyzed the guidelines and methodologies developed by certain credit institutions and international development agencies. The best methodologies, containing relevant scientific issues, were considered those developed by the European Investment Bank (EIB), the European Bank for Reconstruction and Development (EBRD), the World Bank (WB) and the French Development Agency (AFD).

The EIB methodology (EIB, 2012) for assessing GHG emissions associated to its funded projects, is based on the guidelines provisions issued by the Intergovernmental Panel on Climate Change (IPCC), those of the ISO 14064 Standard, the Voluntary Carbon Standard and the GHG Protocol of the World Resources Institute. But not all projects are being evaluated using this methodology, given the necessary resources to be allocated for this analysis; only projects generating significant emissions are considered, i.e. those with absolute emissions greater than 100,000 tons CO_2e and relative emissions greater than 20,000 tons CO_2e. Thus, EIB methodology uses three important concepts that define the scenarios to be analyzed and their results:

- Absolute emissions: those associated to the proposed project to be funded (project scenario or "do something" scenario);
- Baseline emissions: those associated to the scenario without the project (or "do nothing" scenario);
- Relative emissions: the difference between the absolute and baseline emissions, having a positive or negative value, depending on the effect of analyzed project.

It is important to note that the scenario without project does not refer to the previous status of the project, but it corresponds to a credible and realistic alternative meeting the needs or the additional demand intended to be satisfied by the proposed investment (e.g. if the proposed investment refers to a new road, in its absence, the traffic will be distributed on the existing routes, leading to congestion, more rapid deterioration of existing roads etc). Using this kind of evaluating model, the institution can compare the costs with the produced benefits of the project, and avoids obtaining and interpreting one value that can lead to inappropriate decisions.

EIB examines the impact of GHG emissions in tons CO_2 equivalents, taking into account 7 gases included in the Kyoto Protocol: CO_2, CH_4, N_2O, HFC, PFC, SF_6 and NF_3. Another feature of the EIB methodology refers to the emission levels included in the analysis:

- Scope 1 and 2 are mandatory (direct emissions generated within the project boundaries, and indirect emissions: electricity, heating, etc. that can be generated outside the project boundaries);
- Scope 3 will be included only in certain projects (transportation) or in those projects where the upstream or downstream facility is100% dedicated to the analyzed project.

Carbon footprint analysis of EIB projects does not include the implementation period if the project, but only the operating period. Emission factors recommended for using are those specific to the project, and in case of unavailability, IPCC factors will be used. Emissions are calculated for the entire project, even if is required a smaller involvement of the bank in financing the investment.

The methodology used by the EBRD in order to evaluate carbon of funded projects resembles that of EIB, once EIB is one of the shareholders. However, there are specific features in order to simplify the calculation method as (EBRD, 2010):

- Establishing 5 absolute emission thresholds: negligible, low, medium to low, medium to high and high. For projects with negligible emissions, GHG analysis is not necessary, and for projects with low and medium to low emissions, the analysis is optional;

- For projects that do not require Joint Implementation (JI) or Clean Development Mechanism (CDM) accreditation) (except for projects with high emissions) a static baseline scenario is accepted (prior project status);
- Emissions per unit are recommended, to compare the two scenarios, in case of expansion / activity diversification.

The World Bank is currently working on developing a complex methodology for analyzing emissions from future projects. But this initiative is based on a study developed by the experts of World Wide Fund for Nature, for analyzing the bank's carbon footprint generated by project of fossil fuel extraction, production and power generation, funded by the institution, for the 1997 to 2008 period. The activity area of projects was limited and further, certain assumptions have been adopted in order to achieve a simplified and conservative analysis of emissions generated by the major projects assisted by the Bank. Also, not all projects were evaluated, based on the commercial privacy policy, taking into account the potential effects of specific activities on the market. Under these conditions, the emission level taken into account is Scope 1, argued and based on unavailability of data on the origins and the technologies for extracting (data that could affect the whole analysis unless they are accurate). Another feature is using the financial years instead of calendar year, to ensure comparability to financial data (WWF, 2009).

The French Development Agency (AFD, 2011) has developed a model for measuring carbon emissions for its funded projects, having a lower complexity but a wider coverage than the EIB model. Thus, the model takes into account all three emissions levels (scopes), using a database specifically designed for this model, which contains emission factors and correlation factors - allowing direct quantification of emissions from the project size (based on similar projects). Versus the EIB model, the AFD tool includes both the implementation phase of the project (with duration of 1 year) and the operating period (with duration of 20 years, except transport infrastructure: 30 years and dams: 50 years). Additionally, it provides a prevention function for project addiction to energy resources that may be affected in the future by unavailability or severe price fluctuations. The AFD model is materialized in a measuring tool that allows users to enter specific data about the project and returns results on CO2e emissions. The six gases considered are those stipulated in the Kyoto Protocol, but there are also some additional ones, such as traces of water vapour in the stratosphere, condensed water, nitrogen and methane oxides, which together give rise to ozone.

In addition, if the indirect sources of emissions are difficult to quantify, a complementary qualitative analysis can be accepted. An advantage of this tool is using preset scenarios for the reference scenario and the model customization for 27 main types of projects, presenting the main emissions sources for each type of project. The tool also allows introducing data on a multi-sectoral project. The preset scenarios are excluding projects generating negligible emissions (education or health projects).

An important feature of this model is the flexibility and simplicity of the calculation, not focusing on accuracy of results, considering that an analysis performed before the project implementation usually generates approximate values, which are sufficient to assess the investment and provide a decision support for stakeholders.

4. Methodology for developing a carbon footprint model for grant funded projects

Considering the characteristics of the analyzed methodology and their users, we can fit the 4 methodologies presented in two main types: the EIB-EBRD model and AFD-WB model. Each of them presents both advantages and disadvantages; however, given the studied aspect and the prerequisites of developing a measuring model for grant funded projects, we considered appropriate to adopt certain features from each model, and to integrate also other issues from existing methodologies in order to obtain a model simple to use but returning consistent results.

Thus, the most suitable model for evaluating GHG emissions from grant funded projects, will necessarily be addressed to users with a low level of knowledge in carbon emissions and an insufficient awareness of GHG emissions analysis importance. We have considered the difficulties encountered in the performance of the funding programs in Romania in the first programming period 2007-2013, the low absorption rate of EU funds, the reduced number of public awareness activities on problems caused by GHG emissions, the insufficient scientific literature and research in this field on national level and the not necessarily favourable results of the Kyoto commitment. Consequently, we propose a low complexity model for measuring the carbon footprint of investment projects, accessible to any potential grant applicant. The model should integrate numerous preset scenarios, options and data and subsequently, after applicants have understood the necessity of assessing the proposed project potential on climate, the model complexity should progressively increase, also benefiting from new research results and international standardized methodologies.

4.1. General features of the proposed model

The model that we propose in this paper will consider both the project implementation period, and the operating period. The analysed emissions will include the six categories of greenhouse gas stipulated in the Kyoto Protocol. We chose this option because it is the most common, and so various data sources will be available worldwide.

According to the investment NACE code, categories that require or not achieving emission analysis shall be defined.

Table 1. Requirement of the carbon footprint analysis depending on the field of financed activity

NACE code	Activity	Applying the model
01	Agriculture, hunting and related services	Required
10	Food industry	Required
36	Collection, purification and distribution of water	Optional
41	Buildings construction	Required
55	Hotels and other accommodation facilities	Optional
56	Restaurants and other food service activities	Required
72	Research and development	Not required (negligible emissions)
85	Education	Not required (negligible emissions)

Source: Own elaboration

Analysis is optional for projects that can generate a substantial level of emissions, but the effort in achievement the analysis is not productive, data are unavailable or very difficult to obtain, or the industry has not been sufficiently studied. There will not be available preset model for these areas, but if there is sufficient data, users can customize an existing model to achieve a carbon footprint analysis.

Carbon footprint analysis will be required for those areas already studied on international level, for which sufficient data are available, and the level of emissions generated is significant. For major types of such projects, there will be available spreadsheets presenting types of emission sources to be quantified. According to eligible NACE codes on each financing line, every applicant will know the requirement to achieve carbon footprint analysis for the proposed project.

The proposed model is governed by the efficiency principle, so that will comprise two scenarios: baseline scenario and project scenario. Similar to the EIB model, the baseline scenario does not refer to the previous status of the project (e.g. „before and after" analysis), but represents the version that will most likely be adopted in the absence of the proposed project, in order to cover the additional existing demand or to meet the needs that the proposed project is supposed to respond to. Following the AFD model, in order to simplify the calculation, the model will integrate a number of preset reference scenarios for each type of project.

The model will quantify the absolute emissions, associated with the project scenario, the baseline emissions base for the reference scenario, and the relative emissions - the difference between the two scenarios. Relative emissions will register positive or negative values. If the relative emissions are positive, it follows that the project will generate more emissions than the baseline alternative, which does not justify the financial support of the project. As correction method, we propose that in the initial phase of model implementation (2-3 years), the carbon footprint to influence the project selection score, i.e. relative emission projects negative (favourable) should be rewarded with a higher score, increasing the chances of obtaining financing for the applicant, by ranking projects according to their score. Subsequently, after awareness of the need to reduce GHG emissions will increase and potential applicants for grants had accustomed on using the model, we argue that a negative value of relative emission should become one of the eligibility conditions, which if not met, will result in rejection of the application.

The default factors used in the model will be from IPCC database. The model will not allow the use of specific factors in the first phase of implementation, in order to ensure comparability of projects submitted, and for each project scenarios. Using the same values of the emission factors for all applicants, whether approximate values or averages, it will create a basis for comparison.

4.2. Specific features of the proposed model

In terms of emission levels included, we adopt the EIB approach for the operating period: scope 1 and 2, without downstream or upstream emissions, except where the facilities are specifically designed and operating exclusively to serve the proposed project. Concerning the implementation period, it will present the particularity of including scope 3 - only for construction materials (upstream emissions).

Implementation period of the project

Carbon footprint analysis in the implementation phase of the project is a project-centred approach rather than an institution / organization approach. Thus, we are inventorying specific activities that may occur during the implementation of the project. The calculation methodology of the carbon footprint in the implementation phase will be applied to all projects, regardless of its type or the activity involved.

In general, the main activities of a project funded by grants refer to administrative activities: project management, procurement, information and publicity activities; purchase of equipment and facilities: reception, installation, commissioning of equipment; construction works: renovations, upgrades, extensions, new buildings.

Of these three main types of activities, one category that should be considered in terms of emissions generated refers to the construction activities. The activity of acquisitions may involve significant emissions, if the equipment is imported and transported on a long distance. However, in pre-implementation period the suppliers and their location are unknown, given that supply contracts are usually concluded following an acquisition process, when it is necessary to respect the competition principle, providing unrestricted access of any potential tendered in the procedure. The same principle must be respected also for the acquisition of construction works and materials, but the premise of purchasing these from local suppliers is accepted in the international practice, because of the difficulty for long-distance transport of significant quantities of material, and due to a lower price available on the local market. Thus, even if the contractor of construction works is from abroad, the effective use of public funds will most often involve purchasing construction materials from local market.

On the other hand, there are projects types that do not involve construction activities, or are specific to human resources, for developing the institutional capacity, research projects, development and innovation projects, cooperation on trans-national/ international level. Such projects generate low levels of GHG emissions; therefore, it is not necessary to apply the model in the first phase.

Project-oriented approach involves including scope 3 for GHG emissions, only in the implementation phase of the project, for construction materials. Although contrary to initially established premises for the entire model, construction works are generating significant GHG emissions and should be considered. A specificity of EU funds is the eligibility of construction expenditures, but purchasing a new building is not eligible. We consider that in the next programming period this should be reviewed, even if it involves major efforts to establish the framework and procedures for evaluating buildings and for inclusion as eligible expense. In terms of GHG emissions, the situation is clearly more favourable if purchasing and renovating already existing buildings, than constructing a new one. In this regard, it is appropriate to calculate the carbon footprint of projects by taking into consideration the carbon footprint embedded in construction materials (upstream emissions).

Construction work is divided into 3 categories relevant in terms of GHG emissions: preparing and restoring the construction terrain; construction materials; fuel and energy.

Site preparation is relevant in terms of clearing activities and vegetation removal to achieve foundation and construction annexes. Vegetation and trees are sources of carbon sequestration from the atmosphere, and removing them is a process equivalent to increasing the amount of emissions generated. On the other hand, constructors are required by law to bring the land back to the initial phase at the end of the works and to plant other trees to award the lost ones. The model will include the most common tree species, along with related absorption rate (also dependent of constructing area). Sequestration factor is calculated based on the carbon density of the analysed element and the conversion ratio of carbon to CO2 (Melanta, 2010).

Construction materials will be available to choose from the predefined list or inserting new ones, if necessary, could be possible. Predefined materials will be the most commonly found in construction of both buildings, as well as other types of assets (roads, water supply and sewerage, dams etc.): cement/concrete, plastic, steel, aluminium, glass, wood.

Table 2. Emission factors for construction materials

Material type	**UM**	**Emission factor (t CO_2/UM)**
Cement	t	0.52
Steel	t	1.06
Aluminium	t	1.7

Source: IPCC, 2006

The "fuels and energy" category includes elements that generate GHG emissions during the construction activity: use of electricity, heat, fuel for construction machineries and equipment, fuels for transport of construction materials and generated waste (we assume using road transport). For electricity supplied from the national grid, country specific emission factor will be used, calculated according to the proportion of types of included energy sources.

We consider that the carbon emissions generated by the construction has to be correlated with the lifetime of the facility. Depending on the duration, it is possible distributing GHG emissions annually by dividing the total value by the number of years of life expectancy. This creates a viable basis for comparison with other construction and similar projects. Also in this respect, the total carbon emissions level per built m2 can be calculated.

The necessary data to achieve carbon footprint for implementation period will be collected from various documents and reports related to the project, conducted in the pre-implementation phase, such as geotechnical study, feasibility study, estimates and quantities lists, tenders and refinement of cost items made by projectors and / or constructors, study of environmental impact assessment.

Operating period

Comparing to the calculation model for the implementation period, which applies to all projects in the same form, operating period is specific to each business separately. As with AFD, the model should contain project sheets for a number of major types of projects that can be funded. Depending on the type of project, calculation lines will be detailed for the specific activity, in order to guide the user in detailing the sources of GHG emissions throughout the operating period of the investment.

Regarding the lifetime of the financed investments, initially this will not be considered, because data entered will refer to annual values. Thus, we assume that emissions will be constant in each year of operation.

During the operating period of an investment, the sources of GHG emissions can vary depending on the industry, but the most important will cover fuels for stationary and mobile elements, electricity and heat, direct emissions from the production process and storage, waste. Categories to be customized depending on the type of investment are the direct emissions from the production process, storage and waste. Other categories will contain the same detail for any type of project.

Thus, fuel category will include subcategories as transport on land (by road and rail) / air / sea for staff, goods, products; fuels for equipment and production machinery, fuels for production of electricity / heat. Fuels will include coal, wood, diesel, gasoline, LPG, bio fuels, kerosene, oil, etc.

Electricity will be quantified for lighting, equipment operation, production of heat, etc. Power source may be from the national electricity grid, or there may be owned or private sources of energy generation. Renewable energy is not emitting GHG. If private sources of energy, the model will provide the option of manually filling the emission factor (supplied by the energy producer).

In the production-storage process, GHG emissions may occur depending on the activity, substances and materials used in production. Thus, fertilizers and pesticides are used in agriculture, metal casting generates atmospheric emissions, wastewater treatment is using different chemicals, refrigeration emissions are generated in the food industry etc.

Data required calculating the carbon footprint for the operating phase will be collected from the business plan, life cycle analysis of the product / service, the technological flow and detailed description of production process; technologists or specialists in the field should provide data.

5. Conclusions

Consequences of maintaining stable or increasing GHG emissions have become evident both globally and at individual and organizational level. Evolution of CO2 emissions illustrates the necessity for each state to plan more sustainable energy future. Under these circumstances, we consider that any action to reduce GHG emissions is welcomed and should be applied as soon as possible and voluntarily, prior being required by state, by imposing restrictive legislation or corrective actions. Citizens, organizations and politicians at European level, have concluded the need to shift from the actual development to an economy and a sustainable lifestyle, by reducing the negative impact on nature and future generations.

In this paper we present a methodology to develop a model for calculating the carbon footprint for grant funded projects. This approach is consistent with the objective assumed by our country to reduce GHG emissions by 20% until 2020. The proposed model could be integrated in the programmatic documentation in the next financing programming period 2014-2020, in order to be mandatory prepared by grant applicants. The complexity level is reduced, but subsequently and according to the level of familiarity of users in apluing it, the model can be updated and further developed.

While calculating the carbon footprint by taking into account all emissions types: direct and indirect, downstream and upstream, can provide an overview of the environmental impact, this process requires advanced knowledge and considerable resources. As the scientific literature is still in development, we consider important for an organization / institution to apply a simplified model for calculating the carbon footprint that can be easily understood and provide a comparability basis.

The proposed model will provide the basis for a decision making process on choosing a construction option with lower carbon emissions, ever since the planning and design phase. The same issue can be applied for the operating period, by identification of high emissions points and intervening for improvement. However, we consider that the carbon footprint should not be used as a singular and exclusive indicator of sustainability, but together with other complementary indicators that can demonstrate the real impact of the project on both the environment and the society.

Another advantage of the model is contributing to public awareness and education for managing and reducing carbon emissions, by self-evaluation and determination. Similar carbon models can be used in the future for carbon taxes, carbon units allocation or personal carbon trading (Kenny and Gray, 2009).

The proposed model can be applied to other funding programs, for refundable or nonrefundable financing, on national or european level, in our country or any other country. Specifically, it is a model for carbon footprint analysis of an investment project, that can be presented along with cost-benefit analysis and economic efficiency indicators, such as NPV and IRR.

Along with emissions monitoring, also maintaining and developing carbon sequestration capacity are necessary, particularly by regulating and promoting protected areas. By adopting efficient systems for land use planning, and by controlling and monitoring constructions, projects, industrial plants, agriculture, forestry, the protection of all natural and cultural resources will be strengthened, including protected areas, creating capacities for carbon emissions reduction, thereby promoting and supporting a sustainable development.

Acknowledgements

This work was cofinanced from the European Social Fund through Sectoral Operational Programme Human Resources Development 2007-2013, project number POSDRU/107/1.5/S/77213 „Ph.D. for a career in interdisciplinary economic research at the European standards" (DOCCENT).

References

AFD (2011) The AFD Carbon Footprint Tool for projects. Available at http://www.afd.fr/webdav/site/afd/shared/PORTAILS/SECTEURS/CLIMAT/pdf/Carbon%20footprint%20user%20guide%20-%2007.05.2011.pdf.
Aichele, R.; Felbermayr, G. (2011) Kyoto and the Carbon Footprint of Nations, IFO Working Paper No. 103.
ANPM (2011) Raport Anual privind starea mediului in Romania. Available at http://www.anpm.ro/Mediu/raport_privind_starea_mediului_in_romania-15.
Bratu, M. (2010) Gazele cu efect de seră şi standardele din acest domeniu, Standardizarea Journal, 8, p. 4-6.
Deloitte (2010) Previziuni în industria energiei 2010. Available at http://www.deloitte.com/assets /Dcom-Romania/Local%20Assets/Documents/RO/Altele/ro_PreviziuniIndustriaEnergiei_ 012510.pdf.
EBRD (2010) EBRD Methodology for Assessment of Greenhouse Gas Emissions. Available at http://www.ebrd.com/downloads/about/sustainability/ghgguide.pdf.
EIB (2012) The carbon footprint of projects financed by the Bank. Available at http://www.eib.org/attachments/strategies/eib_project_carbon_footprint_methodologies_en.pdf.
Ercin, A.E.; Hoekstra, A.Y. (2012) Carbon and Water Footprints - Concepts, Methodologies and Policy Responses. Paris: United Nations Educational, Scientific and Cultural Organization.
Ernst&Young (2010) Product Carbon Footprinting – a study on methodologies and initiatives - Final report for European Commission - DG Environment. Available at http://wko.at/tirol/ industrie/indakt2010/Folge38/PCF-report.pdf.
IEA (2012) CO2 emissions from fuel combustion – Highlights, OECD/ International Energy Agency.
IPCC (2006) Guidelines for National Greenhouse Gas Inventories. Available at http://www.ipcc-nggip.iges.or.jp/EFDB/main.php.
IPCC (2007) Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate, New York: Cambridge University Press.
Kenny, T.; Gray, N.F. (2009) Comparative performance of six carbon footprint models for use in Ireland, Environmental Impact Assessment Review, 29, 1-6.
Lundie, S.; Schulz, M.; Peters, G.; Nebel, B.; Ledgard, S. (2009) Carbon Footprint Measurement - Methodology Report, Available at http://www.fonterra.com/wps/wcm/connect/944cee00415a e42c834eebd111458f1c/Carbon%2BFootprint%2Bmethodology%2Bfinal.pdf?MOD=AJPERES.
Matthews, H.S.; Weber, C., Hendrickson, C. (2008) Estimating Carbon Footprints with Input-Output Models, International Input-Output Meeting on Managing the Environment, 9 (11), 1-10
Melanta, S. (2010) A tool for quantifying the carbon footprint of construction projects in the transportation sector, Master of Science Thesis - University of Maryland.
Munteanu, C.; Dumitrascu, M.; Iliuta, R.A. (2011) Ecologie şi protectia calitatii mediului. Bucharest: Ed. Balneara.
Nielsen, J.; Luttmer, M.; Van der Hoek, B. (2009) Carbon footprinting of financed emissions, Existing methodologies, A review & recommendations, Rotterdam: BECO Group.
PWC (2012) Too late for two degrees? Low carbon economy index 2012. Available at http://www.pwc.com/en_GX/gx/low-carbon-economy-index/assets/pwc-low-carbon-economy-index-2012.pdf.
Suryata, I. (2010) Carbon Footprint Assessment and Its Reduction Efforts: The Case of Blue Lagoon Company, Master thesis - Reykjavik Energy Graduate School of Sustainable Systems, Reykjavik University & University of Iceland.
Wiedmann, T. and Barrett, J. (2010) A Greenhouse Gas Footprint Analysis of UK Central Government 1990-2008, London: Department for Environment, Food and Rural Affairs
Wiedmann, T.; Minx, J. (2007) A definition of 'carbon footprint'. Technical Report 07-01, Durham: ISA UK Research & Consulting.
Wiedmann, T.; Minx, J. (2008). Ecological Economics Research Trends: Chapter 1 „A Definition of 'Carbon Footprint'", New York: Nova Science Publishers.
WWF (2009) Calculating the World Bank footprint: the WWF methodology. Available at http://assets.wwf.org.uk/downloads/carb_fp_methodology.pdf.